Precast concrete bridge components continue to offer solutions to new challenges, achieving longer spans and greater load capacities. Those capabilities were optimized for a unique project in Manhattan, in the heart of downtown New York, N.Y., that used bridge construction technology in a novel fashion. It features 2400-ton segmental concrete box beams spanning 240 ft to create a platform from which will rise two 1000-ft-tall, class A office skyscrapers, a 60-story luxury condominium tower, a boutique hotel, mixed-use retail space, and an expansive pedestrian plaza linked to the new High Line Park on Manhattan’s west side.

This innovative and challenging solution was devised when Brookfield Office Properties sought to connect the two portions of its 7-million-square-foot development that spanned 15 railway lines and related electrical services near Penn Station in Manhattan, where development area is scarce. The developers wanted to create a platform on which they could build a parking structure topped by a public plaza with two high-rise office buildings flanking the site.

Officials contacted the Manhattan West project construction manager to discuss the possibility of using a launching gantry to build a 240 by 480 ft steel platform over the existing rail lines, located in an open trench 55 ft below street level. The idea was to use some overhead equipment to avoid disrupting activities at track level. Because of the high level of activity at track level, no columns or supports for the platform could be built at rail level. But the steel solution was problematic due to the weight of the girders. Instead, RdE came up with the idea of a segmental platform to span the gap and contacted the construction engineer to start working on the design of this record-length bridge.

The future office buildings’ columns will not bear on the platform itself. The core structures of the building will be founded on bedrock, while the curtain-wall columns will penetrate through deck openings in the platform and extend down to track level. The smaller columns for the parking structure will bear on the platform and support the pedestrian plaza above it.

The site provided major challenges. The project would have to be built in the heart of Manhattan over some of the busiest railway tracks in the world without touching down at track level. Crews had to absolutely ensure the integrity of the girder setting process, to ensure no slippage or accidents would interfere with the rail service. Rail service outages to allow work at track level were available for no more than 2 hours at a few limited times.

Transverse Launching Gantry

The design features sixteen 2400-ton segmental beams, each comprising...
37 to 39 match-cast precast concrete segments that span the 240-ft opening between the two sides of the development. The beams were set in place with a custom-built launching gantry that worked from overhead to construct and set a beam. The gantry ran on rails running parallel to the abutments that supported the beams.

Prior to beginning the installation, a steel temporary protection platform was built over the rail lines. This horizontal space not only protected the rail lines as work was set up, but it served as the underslung bed from which the launching gantry could be assembled and the initial beams could be set into place. After the first two beams were set, the temporary platform was dismantled and the underslung assembly bed was moved to the permanent platform and used as the stage from which subsequent beams were fabricated.

All 39 segments for one beam could be stored in a 6100-ft² yard on the site. The segments, made with 9.5 ksi concrete, could be double-stacked because of the vertical web design of the box, which allowed direct transfer of load from the box above to the webs of the box below. That cross-section geometry allowed the construction sequencing to be simplified and maximized the small available space for staging the segments.

The gantry picked each segment from the staging area using a C-hook that lifted the segment beneath its top slab and carried it into place on top of the underslung equipment. Each segment was set onto three screw jacks to be positioned and aligned with the previous match-cast piece. The segment joints were then epoxied and the first stage tendons were post-tensioned on the underslung bed using the launching gantry. The beam was then moved to a second location on the platform where additional work was performed including tensioning of the remaining tendons using a specially designed and fabricated custom-stressing platform.

**Hydraulic System Lowered Beams**

The gantry moved smoothly and quietly, considering the immense size and weight of the beams being placed. The gantry could move 10 ft per minute and lowered the beams into place at a rate of 0.5 ft per minute. The lowering system consisted of hydraulic cylinders with pins and slotted bars. The pins held the beam in place while the bars were lowered into the next holes, after which the pins were removed and the beam lowered into the next slot via the hydraulic action. This slow, methodical approach ensured that the beam remained under the team’s complete control at all times and eliminated any concern that the lowering process could slip, causing the beam to fall onto the tracks.

Each beam required 100 tons of post-tensioning, using twenty 37-strand and fourteen 31-strand tendons. The 16 girders create a platform 480 ft wide with a 12 ft depth.

---

**BROOKFIELD OFFICE PROPERTIES, OWNER**

**SUPPLIERS:** Launching Gantry Designer & Supplier: DEAL, a subsidiary of RdE USA, Italy and Florida; Launching Gantry Operator & Platform Erector: Metropolitan Walters LLC, New York, N.Y.; Platform Bridge Bearings: Mageba, Bulach, Switzerland; and Drilled Caissons & Foundation Contractor: Posillico Civil & Drilling, Farmingdale, N.Y.

**BRIDGE DESCRIPTION:** Sixteen 2400-ton segmental concrete box beams spanning 240 ft create a platform from which will rise two 1000-ft-tall, class A office skyscrapers, a 60-story luxury condominium tower, a boutique hotel, mixed-use retail space, and an expansive pedestrian plaza linked to the new High Line Park on Manhattan’s west side.
The platform was designed as three distinct sections to allow for movement of the completed structure. Cast-in-place concrete was placed between the end anchor segments to create a rigid diaphragm across each of the three solid structures. The beams and the joints between them were covered with a 6-in.-thick, cast-in-place concrete slab. Conduit was installed in the cast-in-place slab to contain power and control systems for the ventilation system, track and platform lighting, security cameras, power, and other needs.

Pre-engineered steel armored openings were created in the flanges of the beam segments to allow for columns to be installed later. Armored openings were also placed in the webs of the box girders to create ventilation holes to evacuate smoke in case of a fire on the tracks below. Every other girder has these web openings and a fan room for the ventilation system. Smoke would be drawn up through the holes to street level if necessary. The platform also acts as a fire-break with a 4-hour fire rating.

In a typical segmental box girder, the diaphragms would have small access openings of approximately 10 ft². However, the end diaphragms for the platform required an opening of 100 ft² to ensure adequate area for the ventilation system. Typical end diaphragm details wouldn’t work, so instead the diaphragms were placed outboard of the webs and bearings between adjacent girders to provide torsional restraint for the deck system. Numerous form-saver reinforcing bar and duct couplers also were used on end-segment faces to provide the necessary connections to the cast-in-place diaphragms.

As was expected with the magnitude of compressive stress in the structure, small cracks were observed at locations of high-stress concentration such as at the armored openings after post-tensioning. All cracks were relatively small (< 0.01 in.) and were sealed with methacrylate crack sealer.

The members of the construction team worked together closely throughout the project to ensure it ran smoothly under challenging conditions in producing a first-of-its-kind structure. Although the structure is not strictly a bridge, the construction of a platform over an active and busy railway addressed many of the same issues that more typical bridge structures encounter, but on a massive scale.

Girder in the background is shown in the second-stage stressing position. This view also shows the post-tensioning anchorages and large end opening for ventilation.

The project offers great potential for developers in highly congested, high-demand areas. Although the structure is not strictly a bridge, the construction of a platform over an active and busy railway addressed many of the same issues that more typical bridge structures encounter, but on a massive scale.

This innovative and creative solution can be customized to a variety of urban situations, with the combination of top-down construction and precast concrete’s off-site fabrication creating speedy construction with little disruption to the area and a high level of safety. It offers a new and fast way to literally create high-end real estate for development out of thin air.

Phil Marsh is a project engineer with McNary Bergeron in Broomfield, Colo. Andrea Travani is a project manager with Rizzani de Eccher USA in Bay Harbor Islands, Fla.

For additional photographs or information on this or other projects, visit www.aspirebridge.org and open Current Issue.

For more on the specific challenges this project had to meet, see the Concrete Bridge Technology article in this issue.